METHODS, NETWORKS, AND COMPUTER PROGRAM PRODUCTS FOR SELECTIVELY ROUTING COMMUNICATIONS BASED ON ROUTING RULES

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FIELD OF THE INVENTION

The present invention generally relates to communication systems, and more particularly to methods, networks, and systems for routing communications to wireless terminals.

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BACKGROUND

There is a general trend for people to use an increasing number and variety of communication devices. For example, a person may now communicate by a subscriber line phone, wireless cellular phone, wireless pager, wireless data terminal, and email. The variety of communication devices can provide more flexibility for how, when, and where a person can be contacted, but it can also increase the complexity of such communication. For example, each of these communication devices may have unique access requirements and a unique telephone number, data message address, or internet address. Contacting a person who has such a variety of communication devices may involve obtaining a list of the telephone numbers, data message addresses, or internet addresses of the communication devices and guessing as to the best way to contact the person and/or trying different devices until the communication is successful performed.

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SUMMARY

Various embodiments of the present invention selectively route communications to wireless terminals based on routing rules. A wireless terminal identifier and an alternate routing identifier are associated with the wireless terminal. A determination is made as to whether an alternate routing rules has been satisfied. An incoming communication that is directed to the wireless terminal identifier is selectively routed based on the wireless terminal identifier when the alternate routing rule has not been satisfied and/or is routed based on the alternate routing identifier when the alternate routing rule has been satisfied.

In some embodiments of the present invention, the alternate routing rule may be based on the availability on a network of the wireless terminal, based on whether a

threshold amount of memory is available in the wireless terminal, based on whether the wireless terminal is a predefined terminal type, based on whether a predefined service is available for the wireless terminal, based on whether the incoming communication is predefined type of communication (e.g., short message service data

5   message, an enhanced messaging service data message, and/or an email data message), based on time and/or day, and/or based on a predefined routing identifier that may be communicated by a user.

In some more embodiments of the present invention, the wireless terminal identifier may be a wireless phone number, and an incoming communication that is

10   directed to the wireless phone number may be routed to a voice mailbox that is not associated with the wireless network. For example, the voice mailbox may be part of a public switched telephone network. When the incoming communication is a data message, it may be routed based on an internet address that is associated with the alternate routing identifier, based on a telephone number for a mobile terminal that is

15   associated with the alternate routing identifier, and/or based on a telephone number for a pager that is associated with the alternate routing identifier.

In yet some further embodiments of the present invention, an incoming communication may be converted from one form to another before being routed. For example, an incoming text message may be converted to an audible signal and then

20   routed based on the alternate routing identifier. An incoming voice call may be converted to a text message and/or recorded as a data message and then routed based on the alternate routing identifier.

BRIEF DESCRIPTION OF THE DRAWINGS

25   Figure 1 is a block diagram of a communications system according to various embodiments of the present invention.

Figure 2 illustrates a data structure of a registry according to various embodiments of the present invention.

Figure 3 is a flow chart that illustrates operations for routing incoming

30   communications to wireless terminals according to various embodiments of the present invention.

Figure 4 is a flow chart that illustrates operations for routing incoming communications to wireless terminals according to various embodiments of the present invention.

Figure 5 is a block diagram of a wireless terminal according to various embodiments of the present invention.

Figure 6 is a block diagram of a data processing unit according to various embodiments of the present invention.

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DETAILED DESCRIPTION

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which embodiments of the invention are shown. However, this invention should not be construed as limited to the

10 embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

It also will be understood that, as used herein, the term "comprising" or "comprises" is open-ended, and includes one or more stated elements, steps and/or

15 functions without precluding one or more unstated elements, steps and/or functions.

The present invention is described below with reference to block diagrams and/or operational illustrations of methods and systems according to embodiments of the invention. It is understood that each block of the block diagrams and/or operational illustrations, and combinations of blocks in the block diagrams and/or

20 operational illustrations, can be implemented by analog and/or digital hardware, and/or computer program instructions. These computer program instructions may be provided to a processor of a general purpose computer, special purpose computer, ASIC, and/or other programmable data processing apparatus in a system, such that the instructions, which execute via the processor of the computer and/or other

25 programmable data processing apparatus, create means for implementing the functions/acts specified in the block diagrams and/or operational block or blocks. In some alternate implementations, the functions/acts noted in the blocks may occur out of the order noted in the operational illustrations. For example, two blocks shown in succession may in fact be executed substantially concurrently or the blocks may

30 sometimes be executed in the reverse order, depending upon the functionality/acts involved.

It should be understood, that, as used herein, the term "wireless terminal" may include, but is not limited to, a cellular radiotelephone with or without a multi-line display; a pager; a Personal Communications System (PCS) terminal that may

combine a cellular radiotelephone with data processing, facsimile and data communications capabilities; a Personal Data Assistant (PDA) that can include a radiotelephone, pager, Internet/intranet access, Web browser, organizer, calendar and/or a global positioning system (GPS) receiver; and a conventional laptop and/or

5   palmtop portable computer that includes a radiotelephone or other transceiver. A wireless terminal may be configured to communicate according one or more wireless communication protocols, including, but not limited to, ANSI-136, Global System for Mobile Communications (GSM), code division multiple access (CDMA), wideband-CDMA, CDMA2000, Enhanced Data rates for GSM Evolution (EDGE), Universal

10   Mobile Telecommunications System (UMTS), a wireless local area network (WLAN) protocol such as IEEE 802.11b-g and Bluetooth, satellite protocols, private land mobile radio protocols such as PROJECT-25 and Tetra, and/or other communication protocols. Communication protocols as used herein may specify the information communicated, the timing, the frequency, the modulation, and/or the operations for

15   setting-up and/or maintaining a communication connection.

Figure 1 is a block diagram of a communications system for routing communications between communication devices according to various embodiments of the present invention. The communication system includes base stations 100a-b, a wireless network 110, and a Public Switched Telephone Network (PSTN) 120. The

20   base stations 100a-b can communicate over wireless communication channels with wireless terminals, such as, for example, a cellular radiotelephone 10a, a data terminal 10b, and a pager 10c (collectively referred to as "wireless terminals 10a-c"). For purposes of illustration only, it is assumed that the cellular radiotelephone 10a supports at least voice communication, the pager 10c supports at least data

25   communications, and the data terminal 10b supports at least voice and data communications. The wireless network 110 routes communications between the wireless terminals 10a-c, and between the wireless terminals 10a-c and the PSTN 120 and/or the Internet. Although only two base stations 100a-b, one wireless network 110, and three wireless terminals 10a-c are shown, a typical cellular communication

30   system may include hundreds of base stations, many wireless networks, and may serve thousands of wireless terminals.

The PSTN 120 can communicate through subscriber telephone lines 20 with wireline communication devices, such as, for example, a phone 10d, a voice mail device 10e, a facsimile device 10f, and consumer premises equipment (CPE) 10g

(collectively referred to as "wireline communication devices 10d-f"). The PSTN 120 routes communications between the wireline communication devices 10d-g, and between the wireline communication devices 10d-g and the wireless network 110. The PSTN 120 includes a service switch point 122 that services the subscriber

5 telephone lines 20 and can include a storage device 124 that is configured to store voice mail and/or text message for retrieval by a user. Although only one service switch point 122 is shown, a typical regional PSTN can include hundreds of service switch points and can serve millions of subscriber telephone lines.

Each of the wireless terminals 10a-c may be assigned a unique wireless

10 terminal identifier, which may be, for example, a unique number and/or a data network address. For example, wireless terminals that support voice communications (e.g., cellular radiotelephone 10a and data terminal 10b) may be assigned unique phone numbers, and wireless terminals that support data communications (e.g., data terminal 10b and pager 10c) may be assigned unique data network addresses. The

15 wireless terminal identifier of GSM type wireless terminals may be based on International Mobile Subscriber Identity (IMSI) numbers that include a Mobile Country Code (MCC), a Mobile Network Code (MNC), and a Mobile Subscriber Identity Number (MSIN).

The wireless network 110 may include a mobile switching center 112, a

20 registry 114, a call storage device 116, and a data network access component 118. The mobile switching center 112 routes communications, such as voice calls and/or data messages, from, to, and/or between one or more of the wireless terminals 10a-c, the PSTN 120, and the Internet via the data network access component 118. Data messages can include email, short message service data messages, and/or enhanced

25 messaging service data messages. The mobile switching center 112 may include separate networks for routing voice communications and data communications. For example, voice communications may be routed through a point-to-point network and data communications may be routed through a packet switched network. The registry 114 contains information that is used by the mobile switching center 112 to route

30 incoming communications, such as voice calls and/or data messages, that are directed to one or more of the wireless terminals 10a-c.

In some embodiments of the present invention, the registry 114 contains the wireless terminal identifiers and associations between each of the wireless terminal identifiers and one or more alternate routing identifiers. The wireless terminal

identifiers and the alternate routing identifiers may correspond to, for example, telephone numbers for mobile terminals and/or wireline communication devices that are serviced by the PSTN 120, data message routing identifiers for mobile terminals and/or devices that are accessible via the Internet (e.g., Internet addresses), and/or

5   voice mailboxes and/or data mailboxes. The registry 114 may also contain rules that, when satisfied, cause an incoming communication to be routed according to one or more alternative routing identifiers. The registry 114 may also associate other information with the wireless terminal identifiers, such as, for example, service subscription information, information on the present location of a wireless terminal

10   within the communication system, and/or supplemental services information. An exemplary data structure of a registry is shown in Figure 2.

The mobile switching center 112 accesses the registry 114 to determine how to route incoming communications that are directed to one or more of the wireless terminals 10a-c. Figure 3 shows operations that may be used by the mobile switching

15   center 112 to route such incoming communications. At Block 200, an incoming communication is received that includes a wireless terminal identifier. The incoming communication may be received from the PSTN 120 according to the Common Channel Signaling System No. 7 (SS7) protocol for call setup, from the Internet as a data message, and/or from the wireless terminals 10a-c. At Block 210, a

20   determination is made as to whether one or more rules for alternate routing have been satisfied for the incoming communication. The rules that determine whether an incoming communication is routed using an alternate routing identifier may be based on the availability of a wireless terminal addressed by an incoming communication, based on characteristics of the addressed wireless terminal, such as, available

25   memory, terminal type, and/or services available for the terminal, based on the message type (e.g., voice, email, or messaging service message), based on the time and/or day, and/or may be based on settable routing identifiers from a user as to how incoming communications to a wireless terminal are to be routed. The determination as to whether a rule for alternate routing has been satisfied may be made by, for

30   example, the mobile switching center 112 and/or by one of the base stations 110-b that services an area where the wireless terminal is located.

When a rule for alternate routing has not been satisfied at Block 210, the incoming communication is routed at Block 230 based on the wireless terminal identifier associated with the incoming communication. For example, at Block 230

the incoming communication may be routed to the wireless terminal or to a voice mailbox in the call-data storage device 116 of a wireless network with which the wireless terminal is registered.

When a rule for alternate routing is satisfied at Block 210, then at Block 220
5   the incoming communication is routed based on one or more alternative routing identifiers that are associated with the wireless terminal identifier of the incoming communication. Such alternate routing may be in place of, or in addition to, routing based on the wireless terminal identifier. For example, the incoming communication may be routed at Block 220 based on the alternative routing identifier to another
10   wireless terminal, to a wireline communication device that is serviced by the PSTN 120, to a voice mailbox and/or data mailbox in the storage device 116 that is identified by the alternative routing identifier, to a voice mailbox and/or data mailbox in the storage device 124 of the PSTN 120 that is identified by the alternative routing identifier, and/or as a data message that is communicated through the data network
15   access component 118 to the Internet.

In one illustrative embodiment of the present invention, a rule may be established by a user so that data messages that are incoming to a wireless phone are re-routed to a wireless PDA, which may be in place of, or in addition to, routing of the data message to the wireless phone. For example, the identifier for the wireless PDA
20   may be associated with the identifier of the wireless phone in, for example, the registry of Figure 2. Such alternate or additional routing may allow a user to receive, view, and/or respond to the incoming data message using the user interface provided by the PDA, instead of using the wireless phone user interface. In another illustrative embodiment, a rule may be established so that incoming emails that are directed to a
25   laptop computer are re-routed, or additionally routed, to a wireless PDA and/or wireless phone. A user may thereby use the PDA or wireless phone to communicate via email during meetings or where use of a laptop computer may not be preferred (e.g., during meetings). Additional rules may be established, as was discussed above with reference to Figure 3, so that the alternate routing is performed based on a
30   routing indication made by a user (e.g., toggling routing ON/OFF to one or more communication devices), based on the availability of the wireless phone, PDA, and/or laptop computer, based on available memory, type, or available service for the addressed device, based on the message type (e.g., voice, email, or messaging service message), and/or based on the time and/or day.

When more than one alternate routing identifier is associated with the wireless terminal identifier, an incoming communication may be routed sequentially based the alternate routing identifiers using, for example, rules that are defined by a user as to communication device availability, prioritization, and/or a daisy chain type sequential attempt of the alternate routing identifiers until the communication is successfully received by a communication device. Alternatively, or additionally, an incoming communication may be routed in parallel based on a plurality of the alternate routing identifiers.

In an illustrative embodiment of the present invention, a user may define sequential routing rules in which SMS messages from a defined phone A are re-routed to another defined phone B if the phone B is available on a network. When phone B is not available, then the SMS messages are re-routed to a defined PDA A if the PDA A is available on a network. When the PDA A is not available, then the SMS messages are re-routed to a defined POP3 account A.

An incoming communication may be converted at Block 220 from one form to another, such as, for example, from a voice call to a data message that is then routed as a data message, and/or from a text message to an audible signal that is then routed as a voice call. Figure 4 shows operations that may be used at Block 220 of Figure 3 to convert and then route communications based on an alternate routing identifier. At Block 300 a decision is made as to whether an incoming communication is a text message. If it is a text message, then at Block 310 the text message is converted to an audible signal using, for example, a conventional text-to-speech program and/or circuitry. The audible signal is then routed at Block 320 as a voice call based on the alternate routing identifier.

When the incoming communication is not a text message at Block 300, then a decision is made at Block 330 as to whether to the incoming communication is a voice call. If it is a voice call, then at Block 340 speech in the voice call may be converted to a text message using, for example, a conventional speech-to-text program and/or circuitry. At Block 350 the text message may then be routed based on the alternate routing identifier. In addition to, or as an alternative to the conversion and routing operations of Blocks 340 and 350, the voice call may be recorded as a data message at Block 360 and routed at Block 370 based on the alternate routing identifier. Thus, based on a defined routing rule, the voice call may be converted to a text message and/or to a data message, and then routed to the wireless terminal and/or

to another communication device that is associated with the alternate routing identifier. For example, a wireless terminal that is unavailable for receiving a voice call, but which is available to receive a data message, may receive a voice call as a data message. Similarly, a wireless terminal that is unavailable for receiving a data

5   message, but which is available to receive a voice call, may receive a data message as a voice call. If the incoming communication is not a voice call at Block 330 (e.g., picture message), then at Block 380 the communication may be routed unchanged based on the alternative routing identifier.

The associations between the wireless terminal identifiers and the alternate

10   routing identifiers may be defined by users. For example, a user may define an alternate routing identifier to which incoming communications to a wireless terminal are to be redirected when the wireless terminal is not available. A user may define the alternate routing identifier using, for example, the wireless terminal, a wireline communication device, and/or by logging into a website that is associated with the

15   wireless network 110, such as by access the data network access component 118 via the Internet. A defined alternate routing identifier may be communicated from a wireless terminal to the wireless network 110 as a data message, such as a short message service data message, an enhanced messaging service data message, and/or as an email message. The alternate routing identifier may be communicated with the

20   wireless terminal identifier to the wireless network 110, and/or the wireless network 110 may determine the wireless terminal identifier of the wireless terminal based on information that is received from the wireless terminal (e.g., MSIN of the wireless terminal). Communication of the alternate routing identifier from a wireless terminal identifier to the wireless network 110 may wait until before the wireless terminal

25   turns-off. The associations between the wireless terminal identifiers and the alternate routing identifiers may be additionally or alternatively be defined by an operator of the wireless network 110. For example, an operator may define the associations so that if a wireless terminal is unavailable to receive one form of data message, such as an email message, then the data message is automatically routed as another form of

30   data message, such as a short messaging service data message and/or enhanced messaging service data message.

Figure 5 illustrates an exemplary embodiment of a wireless terminal 400 that is suitable for defining and communication an alternate routing identifier according to various embodiments of the present invention. The wireless terminal 400 includes a

processor 410, a memory 420, and a transceiver 430, and may further include an input device 440 (e.g., keyboard, keypad), a display 450, a microphone 460, and a speaker 470. The memory 420 may include one or more erasable programmable read-only memories (EPROM or Flash EPROM), battery-backed random access memory

5 (RAM), magnetic, optical, or other digital storage device, and may be separate from, or at least partially within, the processor 410. The transceiver 430 typically includes both a transmitter and a receiver to allow two way communications, but the present invention is not limited to such devices and, as used herein, a "transceiver" may include both a receiver and a transmitter or only one such communication circuit. The

10 wireless terminal 400 may, thereby, communicate with the wireless network 110 using radio frequency signals. The radio frequency signals may be communicated through an antenna 480 over at least one communication channel with the wireless network 110.

Figure 6 illustrates an exemplary embodiment of a data processing unit 500

15 that is suitable for use as one or more of the components of the wireless network 110. The data processing unit 500 typically includes a processor 510 that communicates with a memory 520 and I/O data ports 530. The memory 520 may be configured to store the data structure of the registry 114 (Figure 1). The data processing unit 500 may also include input device(s) 540 such as a keyboard or keypad, and a display 550

20 that also communicate with the processor 510. The I/O data ports 530 can be used to transfer information between the data processing unit 500 and another component of the wireless network 110, the base stations 100a-b, and/or the PSTN 120. These components may be conventional components such as those used in many conventional wireless networks and/or mobile switching centers which are configured

25 to operate as described herein.

In the drawings and specification, there have been disclosed typical preferred embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being set forth in the following claims.